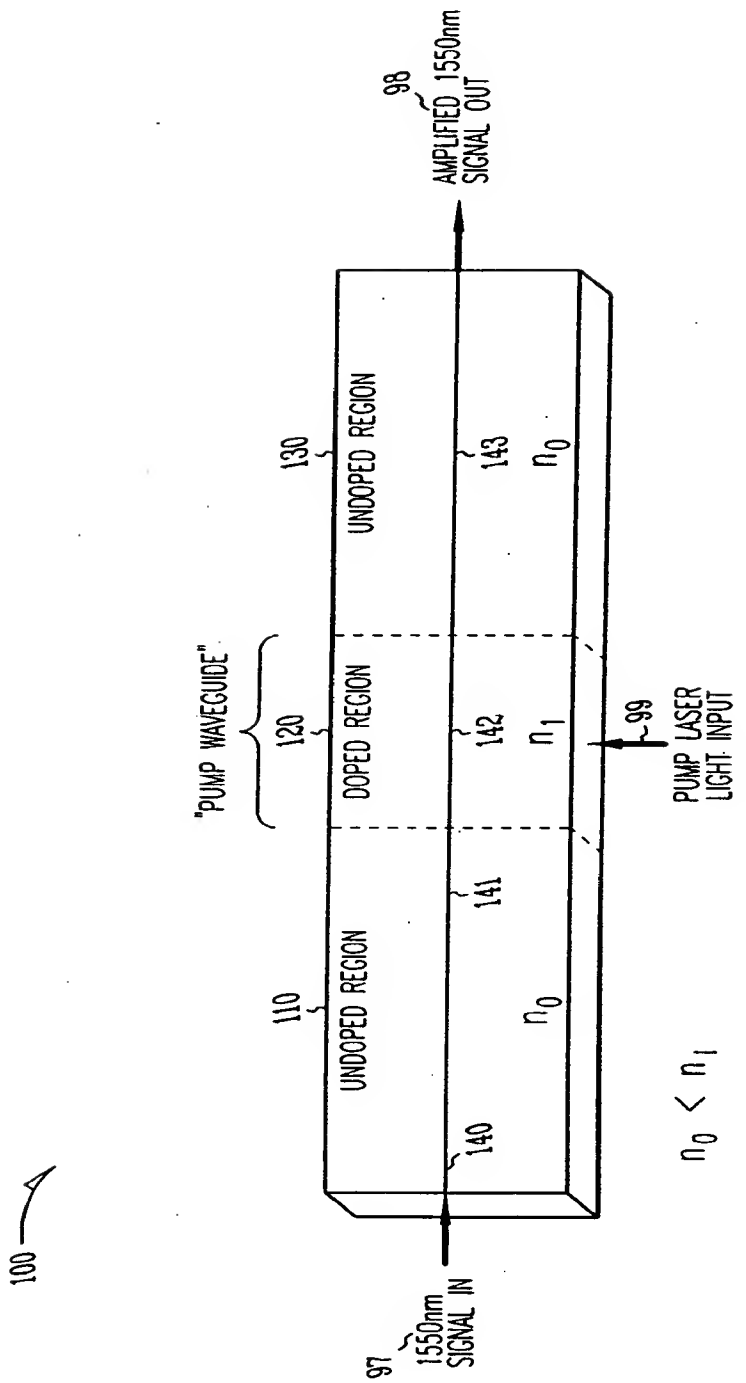

100
97
1550nm
SIGNAL IN
98
AMPLIFIED 1550nm
SIGNAL OUT
99
PUMP LASER
LIGHT INPUT
"PUMP WAVEGUIDE"
110
UNDOPED REGION
120
DOPED REGION
130
UNDOPED REGION
140
141
142
143
n_0
n_1
$n_0 < n_1$

Fig. 1

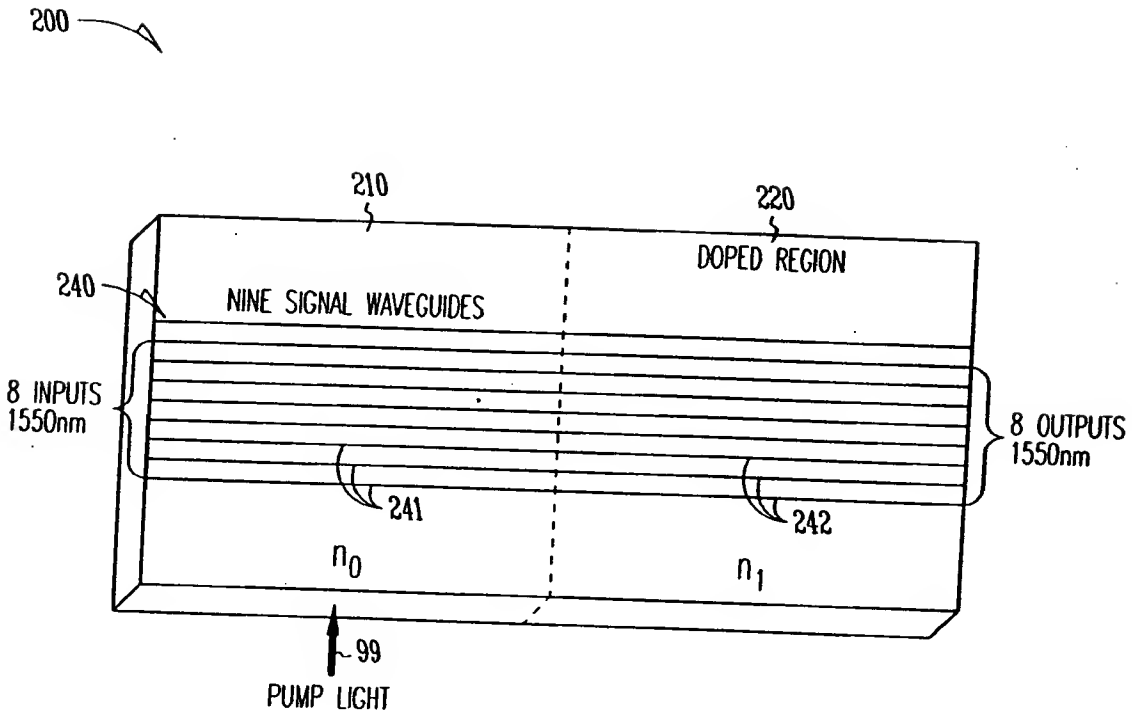

200
210
220
DOPED REGION
240
NINE SIGNAL WAVEGUIDES
8 INPUTS
1550nm
8 OUTPUTS
1550nm
241
242
n_0
n_1
99
PUMP LIGHT

Fig.2

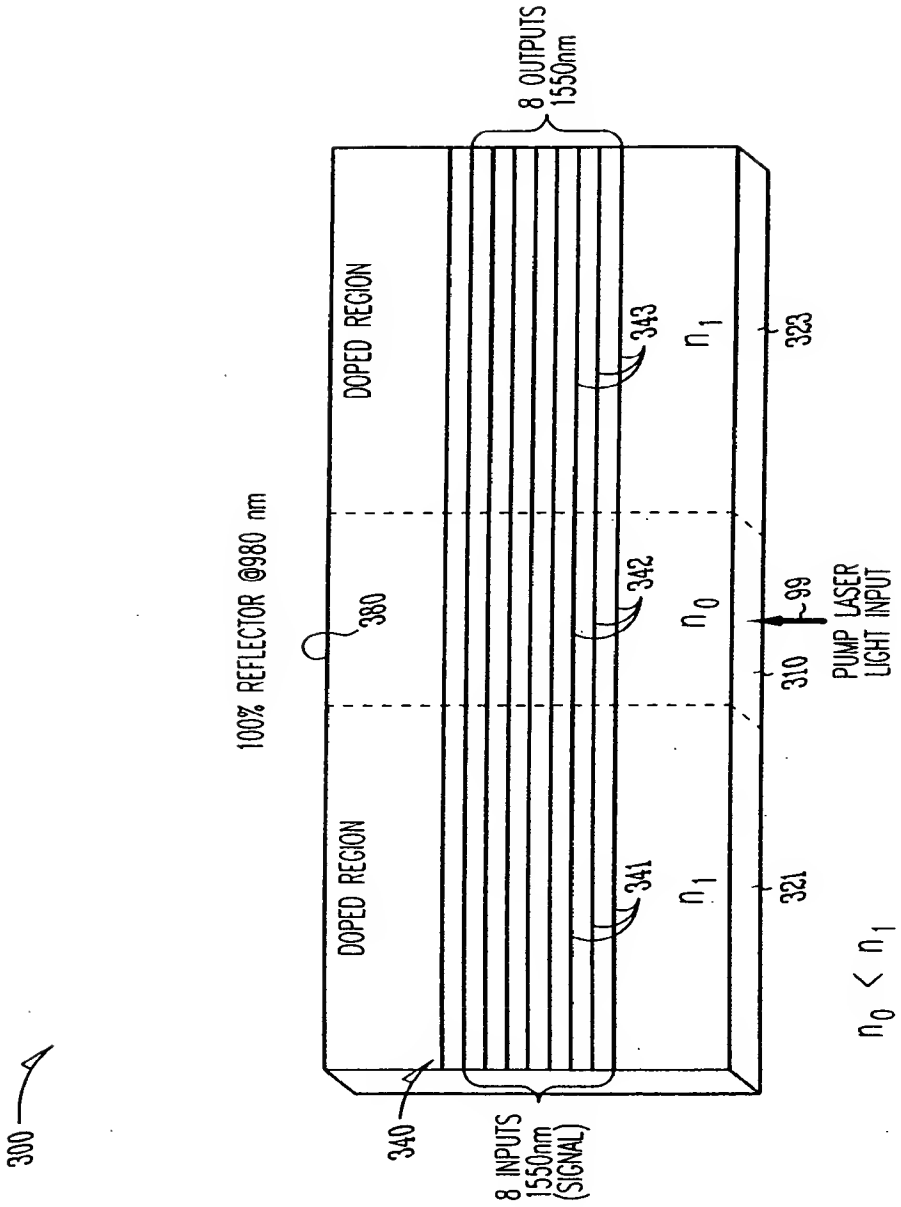

300
340
8 INPUTS
1550nm
(SIGNAL)
8 OUTPUTS
1550nm
DOPED REGION
DOPED REGION
100% REFLECTOR @980 nm
380
341
342
343
n_1
n_0
n_1
321
310
323
99
PUMP LASER
LIGHT INPUT
$n_0 < n_1$

Fig.3

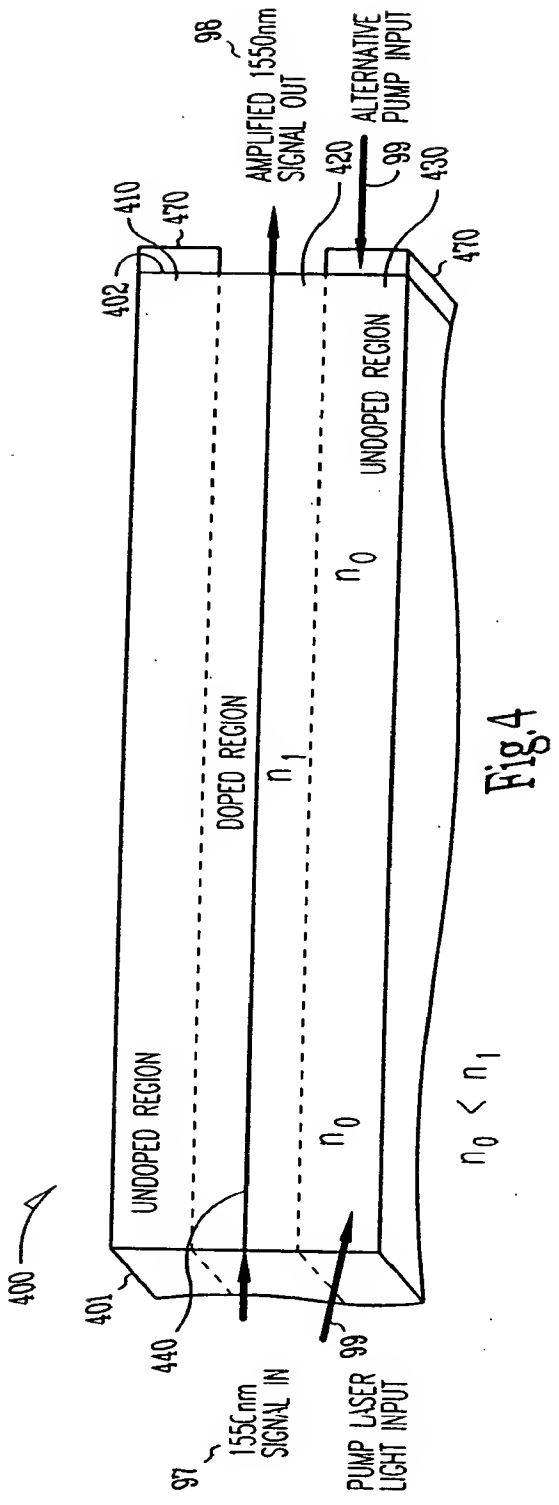

400
401
402
410
470
UNDOPED REGION
DOPED REGION
n_1
n_0
$n_0 < n_1$
440
97
1550nm SIGNAL IN
99
PUMP LASER LIGHT INPUT
98
AMPLIFIED 1550nm SIGNAL OUT
420
99
ALTERNATIVE PUMP INPUT
430
470

Fig.4

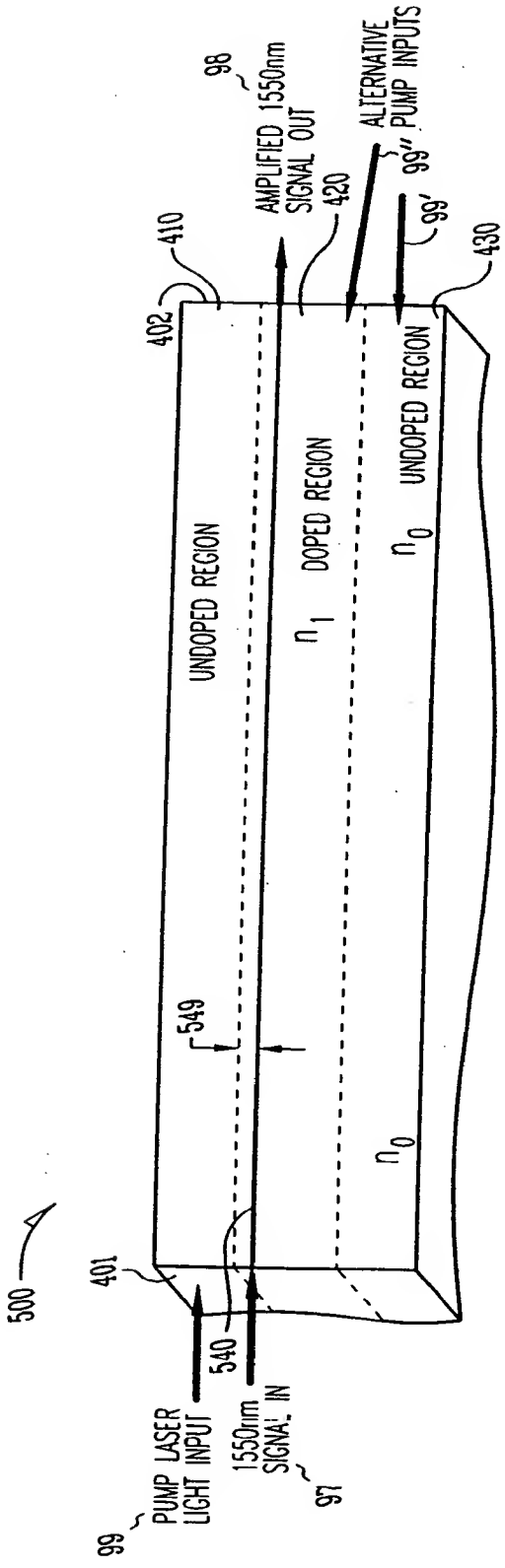

500
401
402
410
UNDOPED REGION
DOPED REGION
n_1
n_0
549
540
97
1550nm SIGNAL IN
99
PUMP LASER LIGHT INPUT
98
AMPLIFIED 1550nm SIGNAL OUT
420
99''
ALTERNATIVE PUMP INPUTS
99'
430

Fig.5

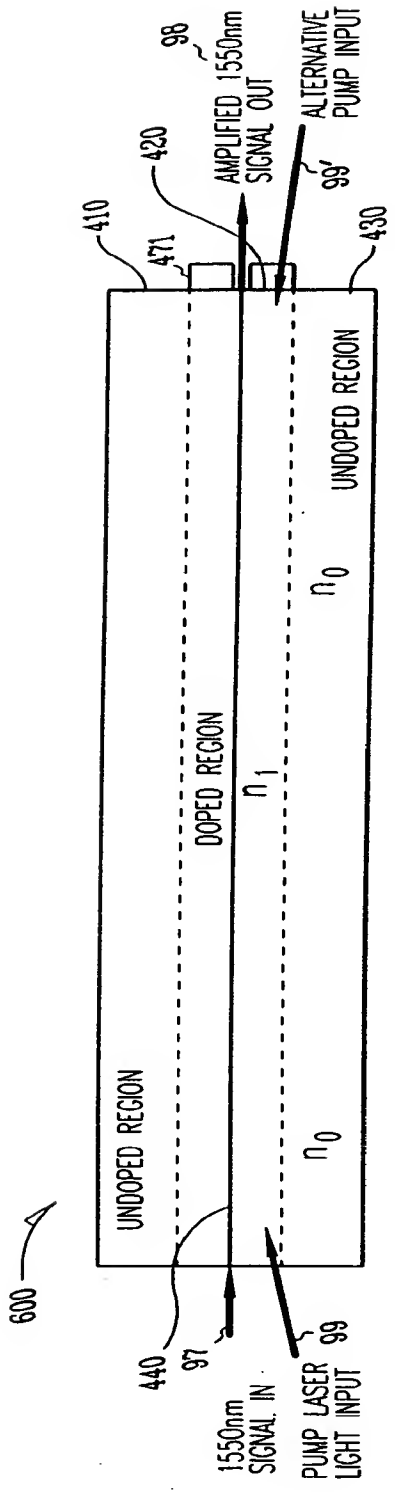

600
UNDOPED REGION
DOPED REGION
UNDOPED REGION
410
471
420
430
440
98
97
99
99'
AMPLIFIED 1550nm SIGNAL OUT
ALTERNATIVE PUMP INPUT
1550nm SIGNAL IN
PUMP LASER LIGHT INPUT
n_0
n_1
n_0
$n_0 < n_1$

Fig.6

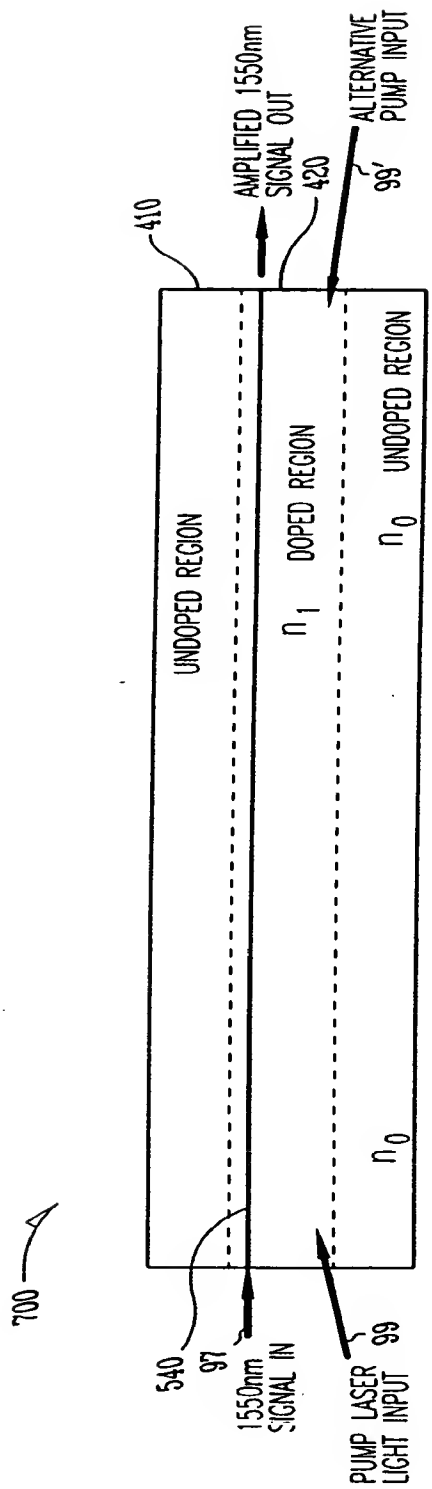

700
UNDOPED REGION
DOPED REGION
UNDOPED REGION
410
420
540
97
99
99'
AMPLIFIED 1550nm SIGNAL OUT
ALTERNATIVE PUMP INPUT
1550nm SIGNAL IN
PUMP LASER LIGHT INPUT
n_0
n_1
n_0

Fig.7

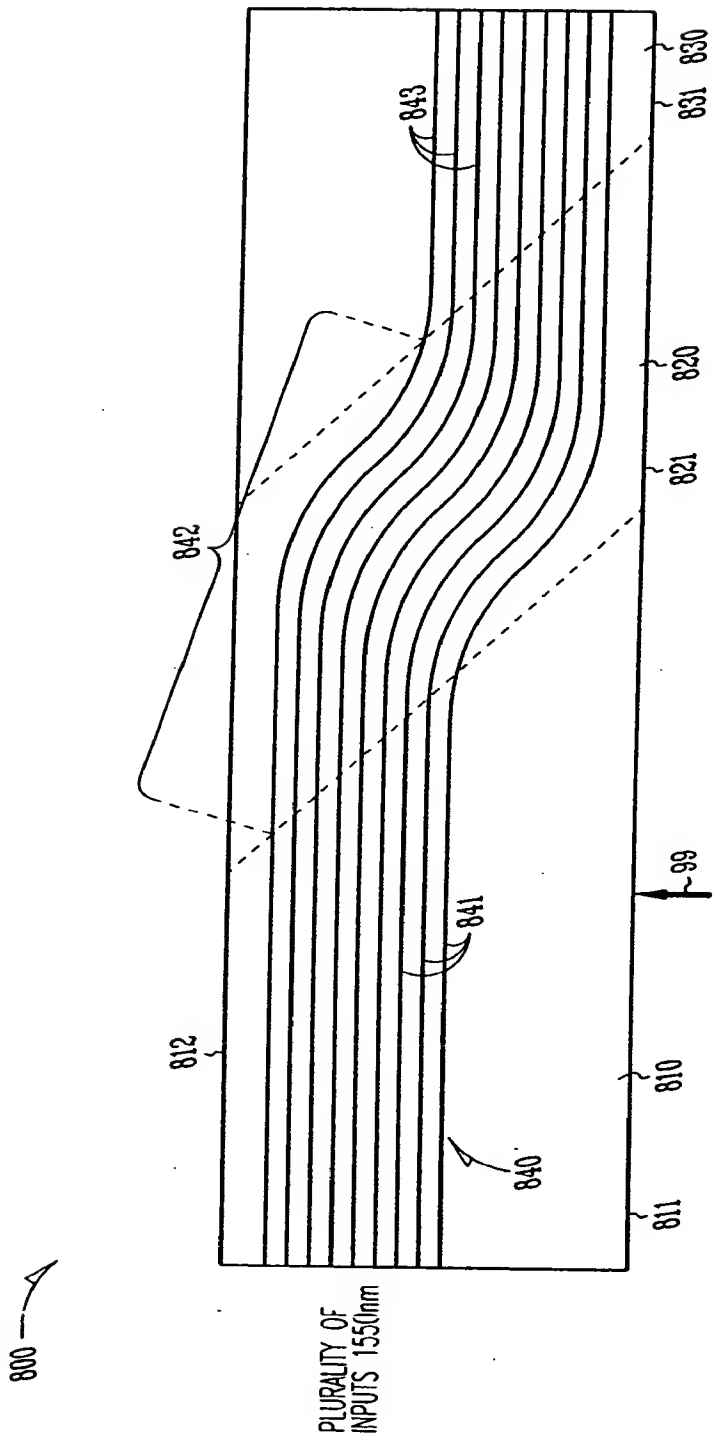

800
PLURALITY OF INPUTS 1550nm
812
842
843
841
840
99
810
811
820
821
830
831

Fig.8

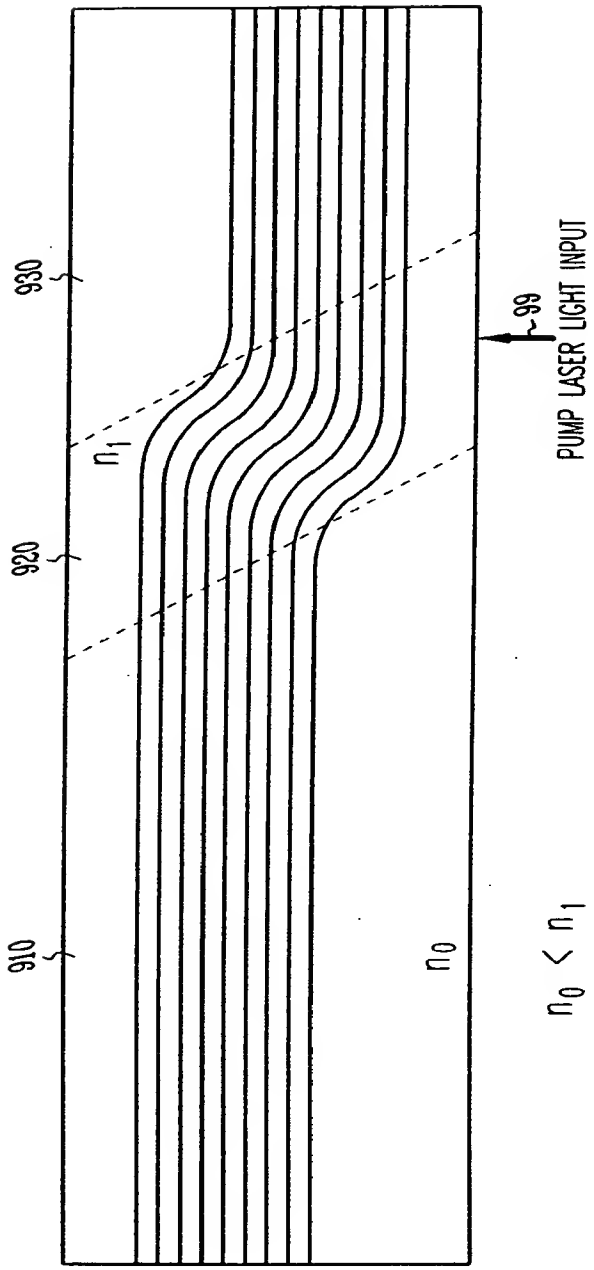


Fig. 9.

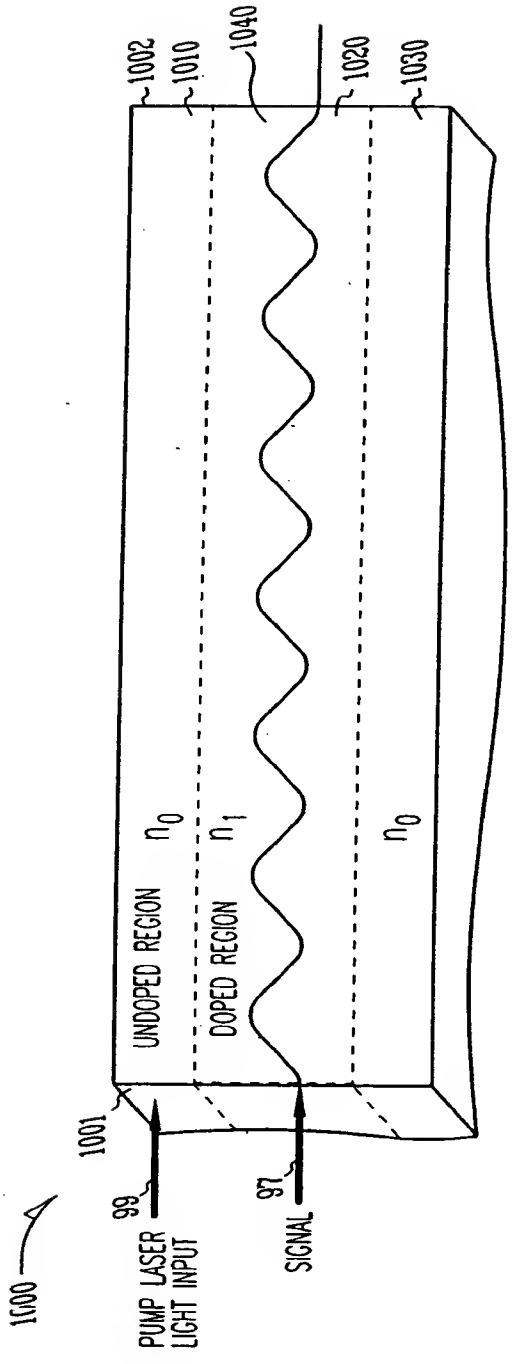

1002
1010
1040
1020
1030
UNDOPED REGION
DOPED REGION
n_0
n_1
n_0
1001
99
97
PUMP LASER LIGHT INPUT
SIGNAL
1000

Fig.10

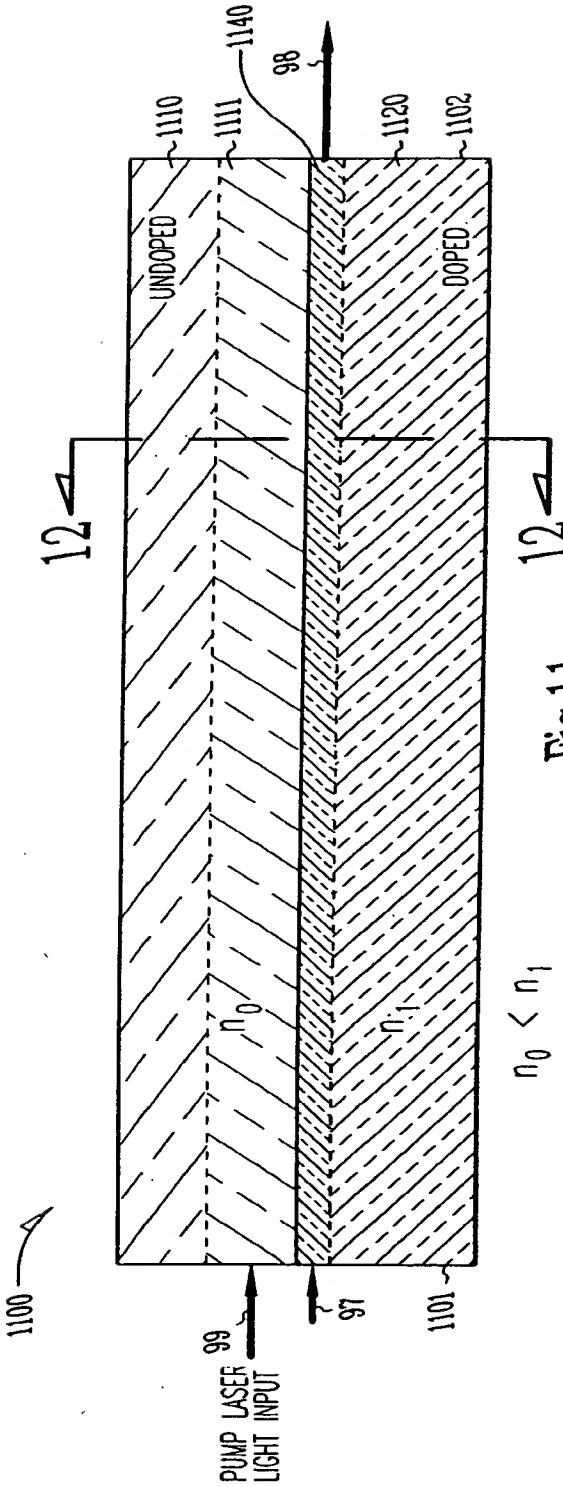

1140
98
1110
1111
1120
1102
UNDOPED
DOPED
12
12
n_0
n_1
$n_0 < n_1$
1100
99
97
1101
PUMP LASER
LIGHT INPUT

Fig.11

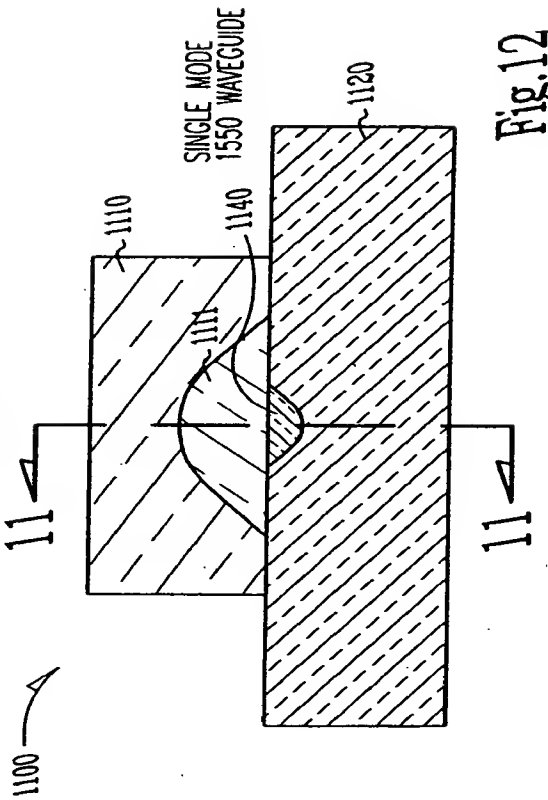

SINGLE MODE
1550 WAVEGUIDE
1120
1110
1140
1111
11
11
1100

Fig.12

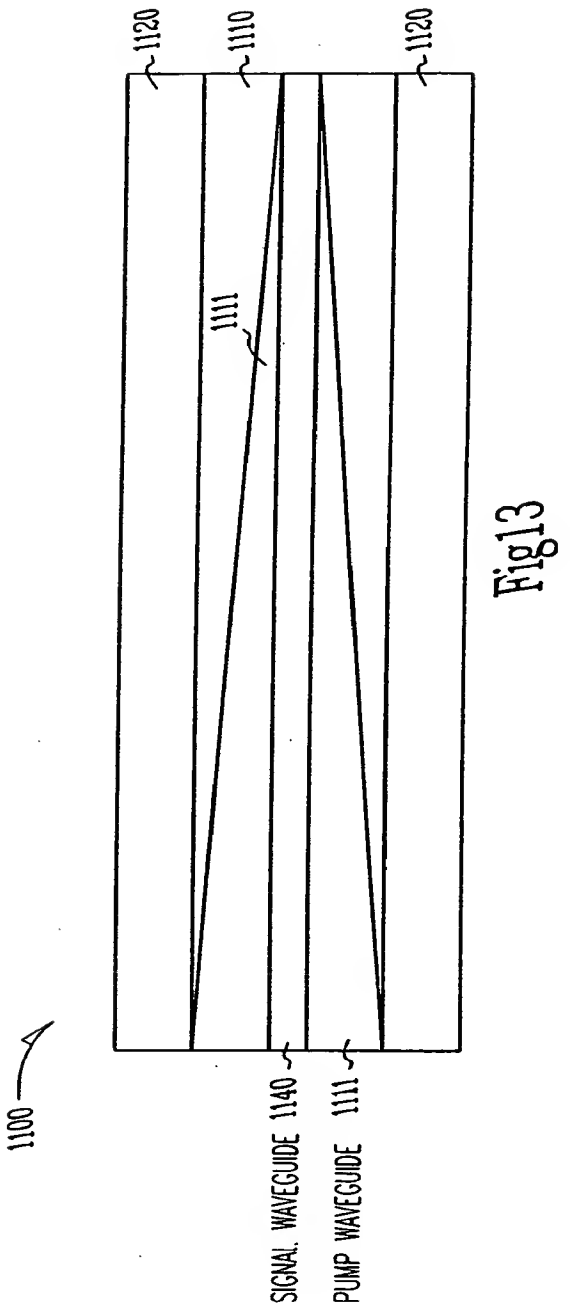

1120
1110
1120
1111
1100
SIGNAL WAVEGUIDE 1140
PUMP WAVEGUIDE 1111

Fig13

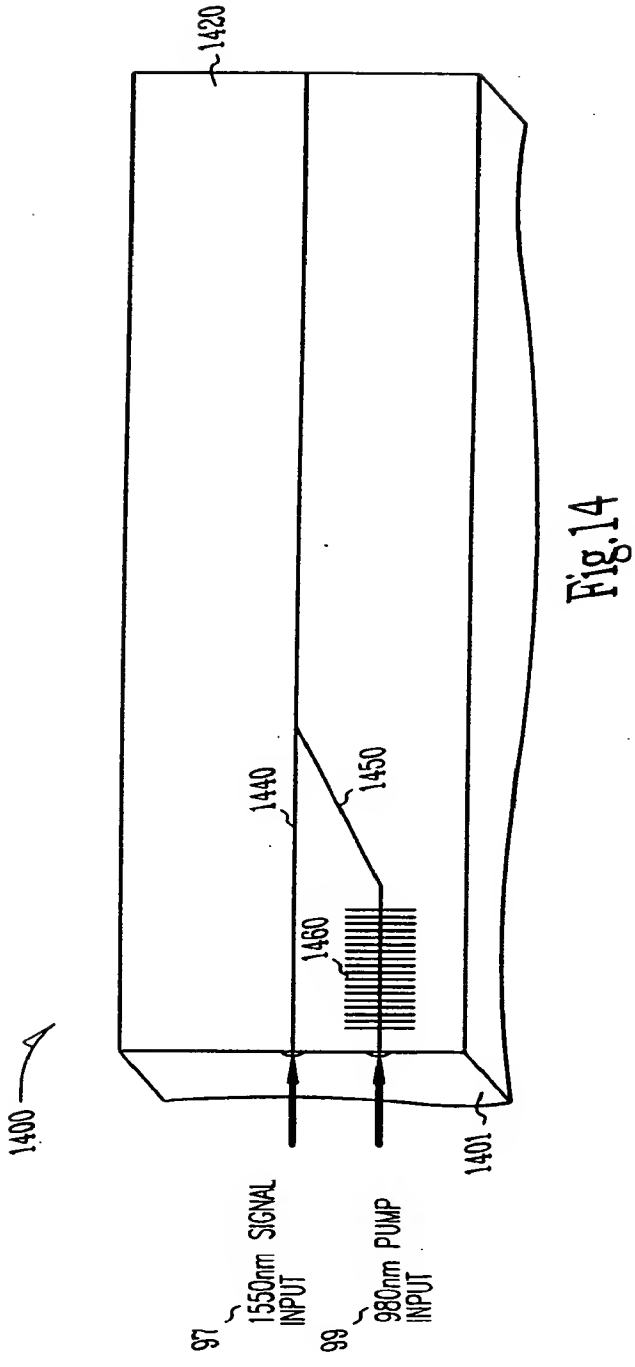

1420
1440
1450
1460
1400
1401
97
1550nm SIGNAL INPUT
99
980nm PUMP INPUT

Fig.14

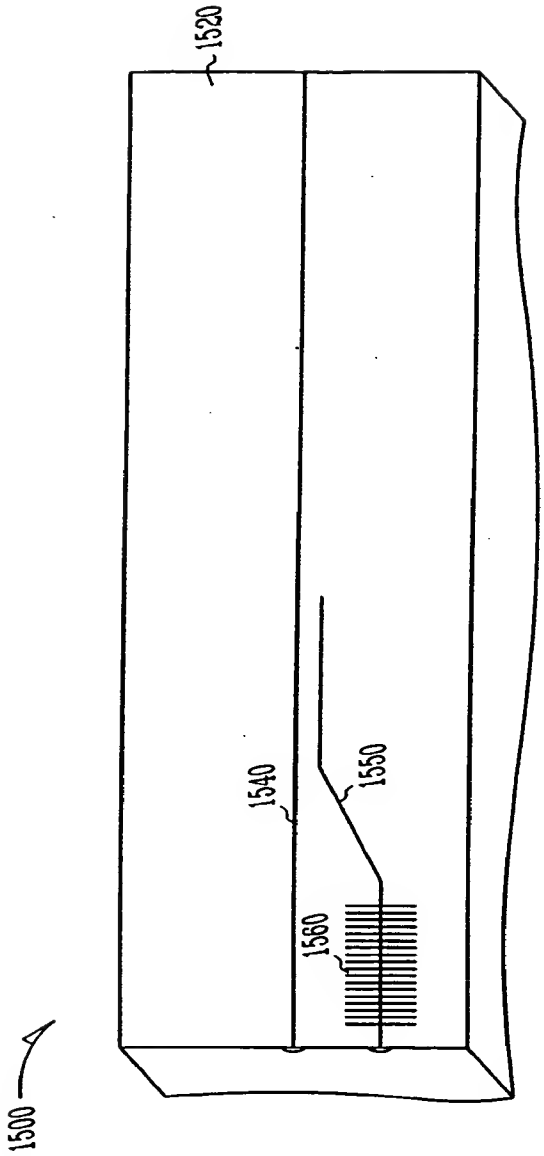

1500
1520
1540
1550
1560

Fig.15

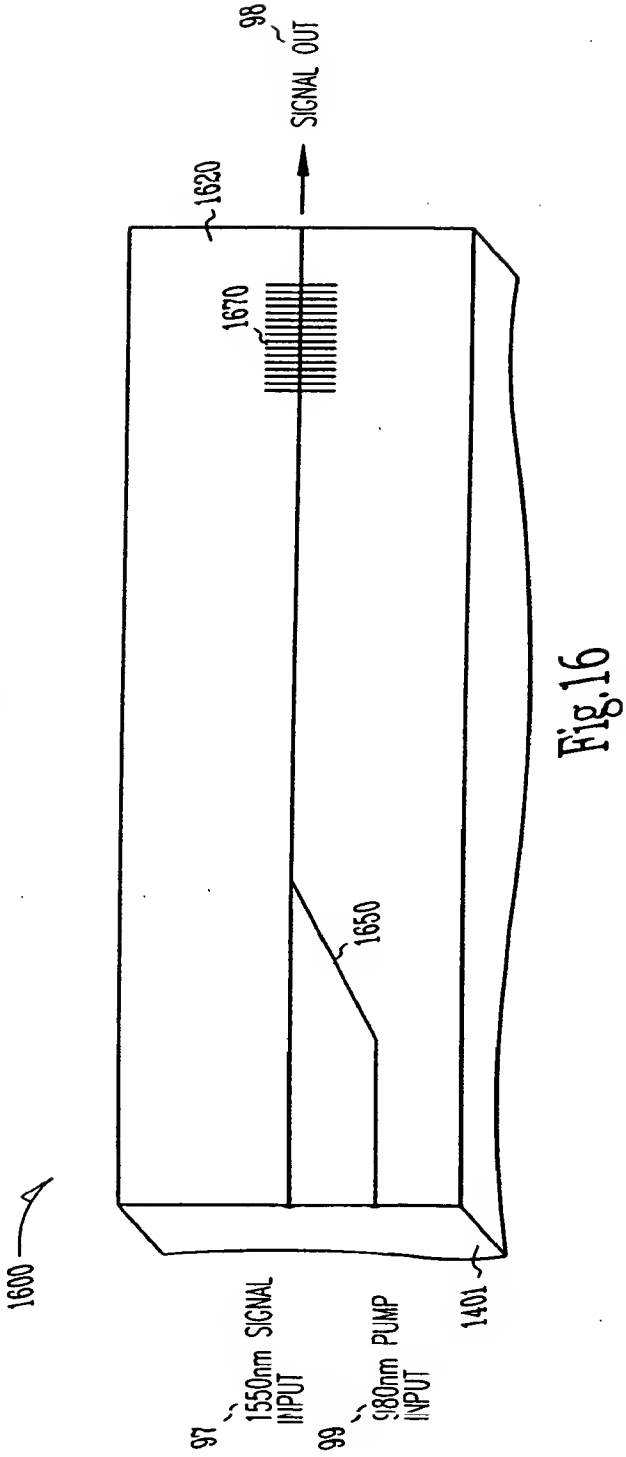

98
SIGNAL OUT
1620
1670
1650
1600
1401
97
1550nm SIGNAL INPUT
99
980nm PUMP INPUT

Fig.16

FIG.17

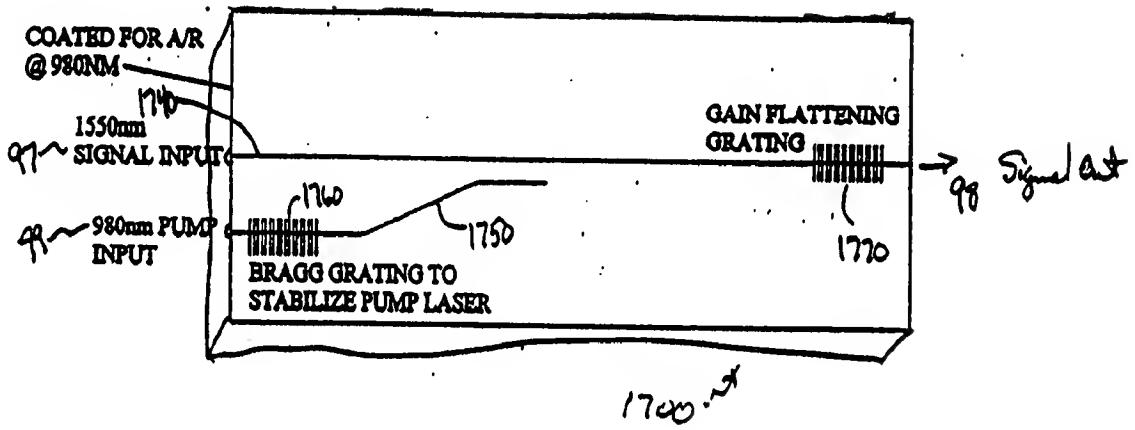

COATED FOR A/R @ 980NM
1740
1550nm SIGNAL INPUT
97
980nm PUMP INPUT
99
1760
1750
BRAGG GRATING TO STABILIZE PUMP LASER
GAIN FLATTENING GRATING
1770
98
Signal out
1700

FIG. 18

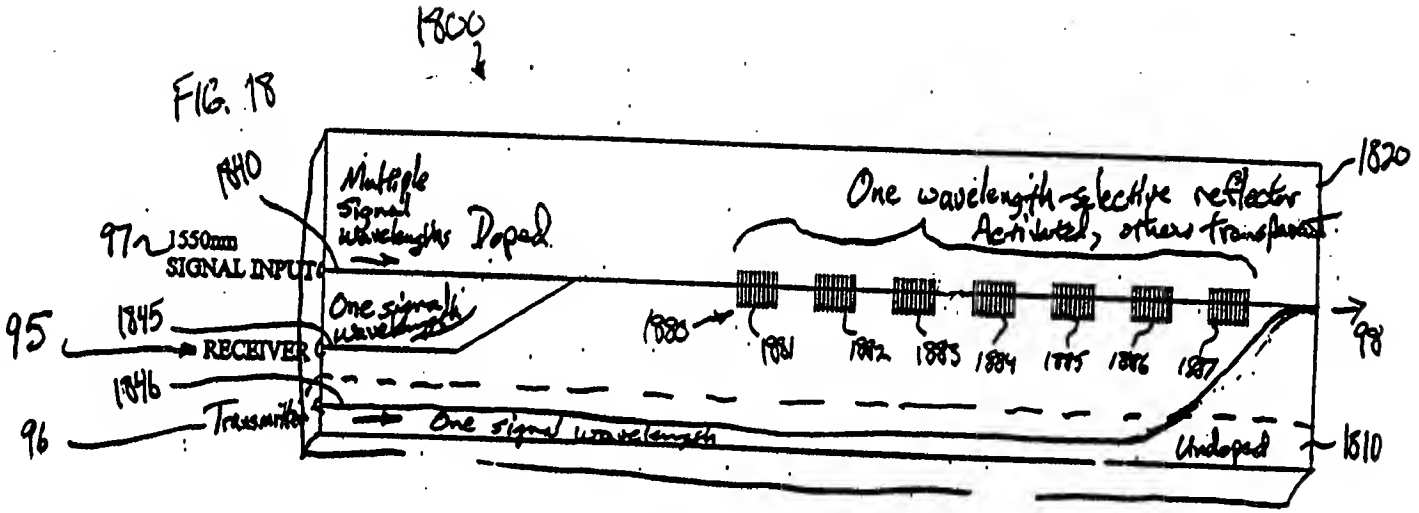

1800
1840
Multiple signal wavelengths Doped
1820
One wavelength-selective reflector Activated, others transparent
97
1550nm SIGNAL INPUT
One signal wavelength
95
1845
RECEIVER
1846
96
Transmitter
1881
1882
1883
1884
1885
1886
1887
98
One signal wavelength
Undoped
1810

FIG.19

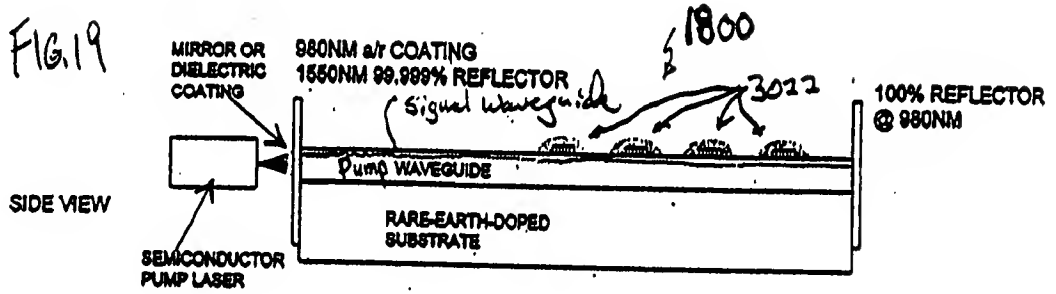
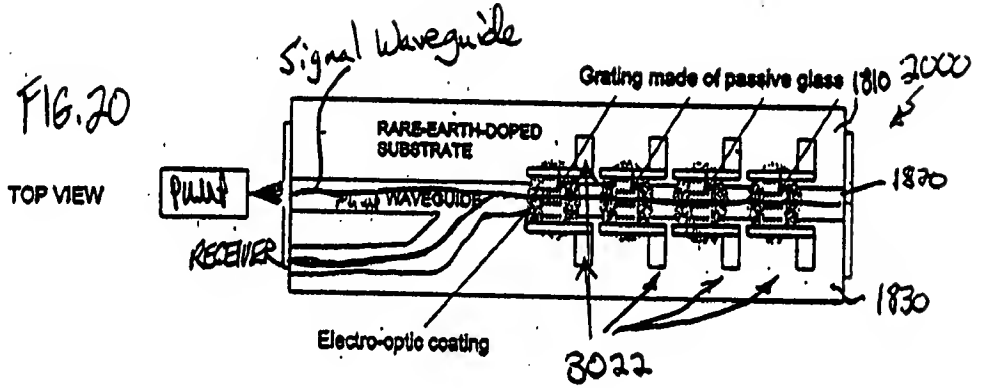

MIRROR OR DIELECTRIC COATING
980NM a/r COATING
1550NM 99.999% REFLECTOR
1800
Signal Waveguide
3022
100% REFLECTOR @ 980NM
SIDE VIEW
Pump WAVEGUIDE
RARE-EARTH-DOPED SUBSTRATE
SEMICONDUCTOR PUMP LASER

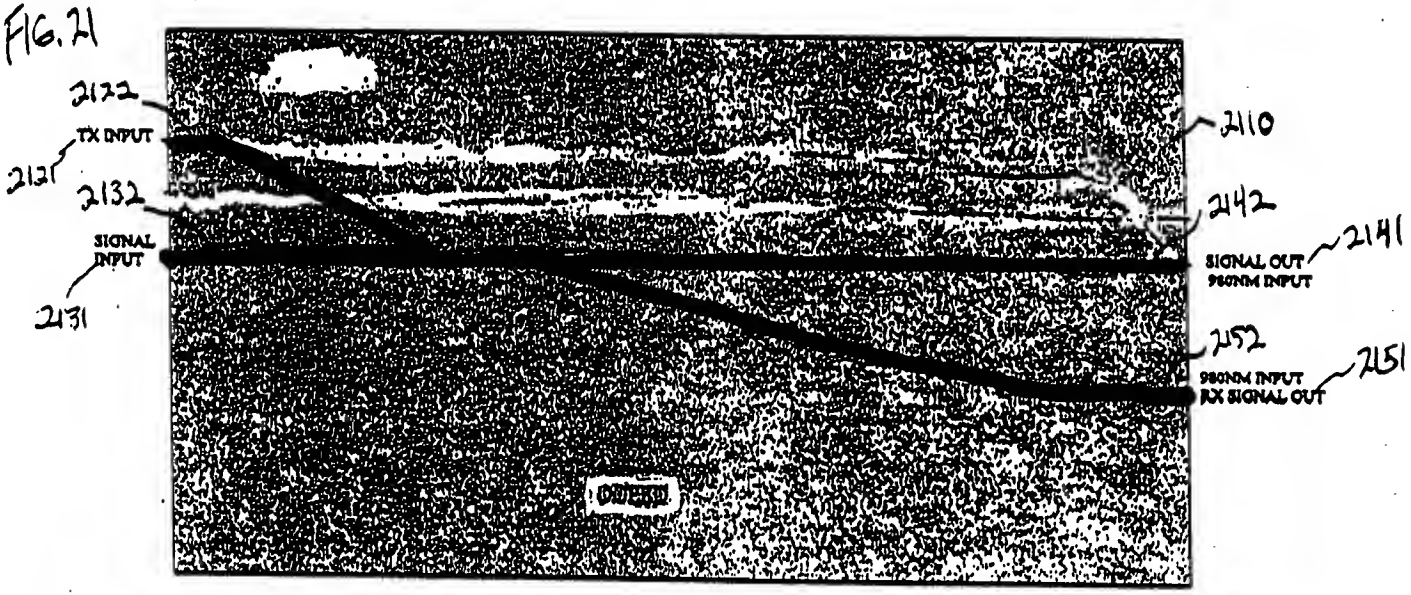
FIG.20


Signal Waveguide
Grating made of passive glass
1810
2000
RARE-EARTH-DOPED SUBSTRATE
TOP VIEW
Pump
Pump WAVEGUIDE
1820
RECEIVER
1830
Electro-optic coating
3022

2100

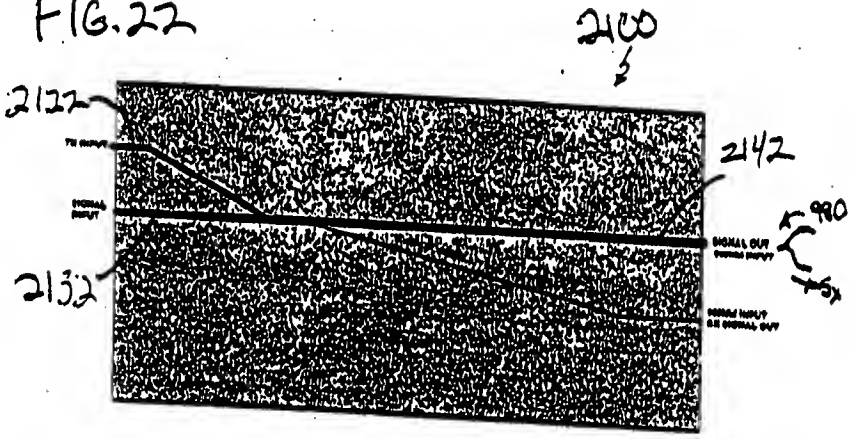
ADD/DROP NODE WITH AMPLIFICATION

FIG. 21



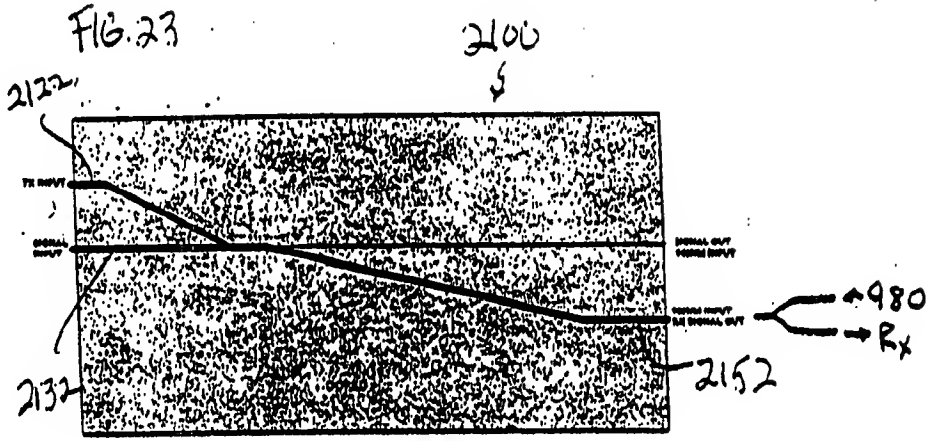
USES BOTH THE ATTENUATION AND AMPLIFICATION CHARACTERISTICS OF RARE-EARTH-DOPED GLASS TO ROUTE THE SIGNAL.

FIG. 22



AMPLIFIED BYPASS MODE (OLD SIGNAL PASSED STRAIGHT THROUGH)

FIG. 23



RECEIVE MODE (OLD SIGNAL OUT, NEW SIGNAL IN)

BOTH THE OUTPUT AND RX OUT COULD HAVE WDM'S OR SPLITTERS TO COMBINE THE 980 AND 1550 SIGNALS.

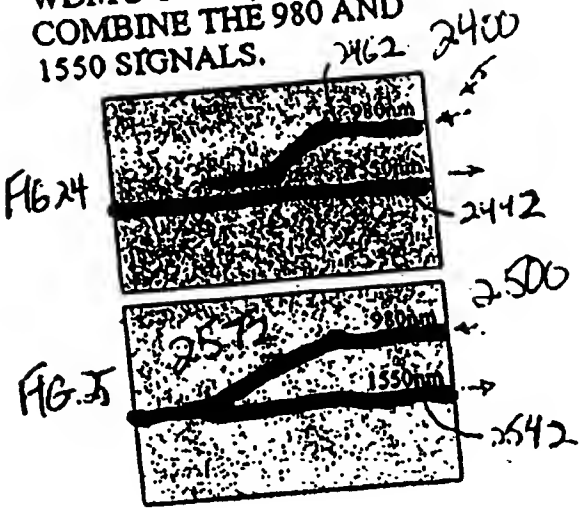


FIG 24

FIG. 25

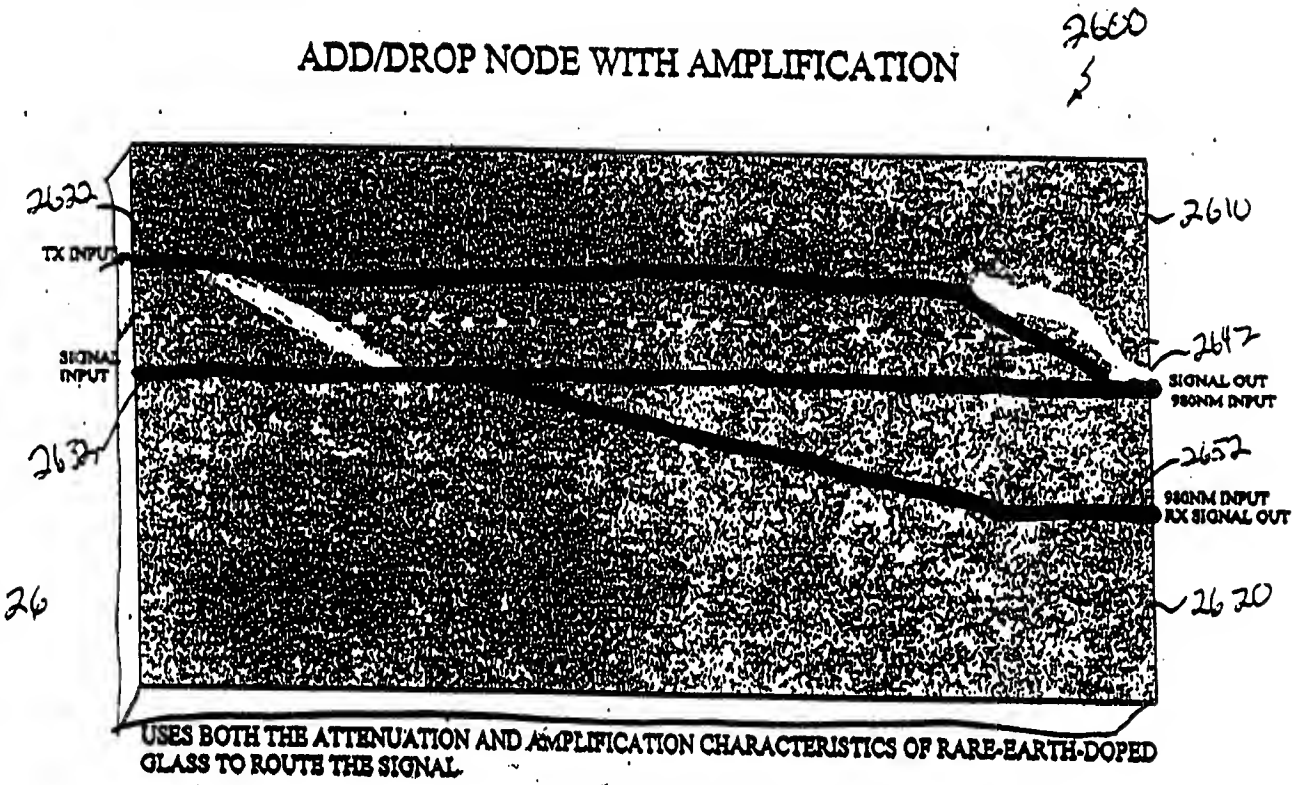
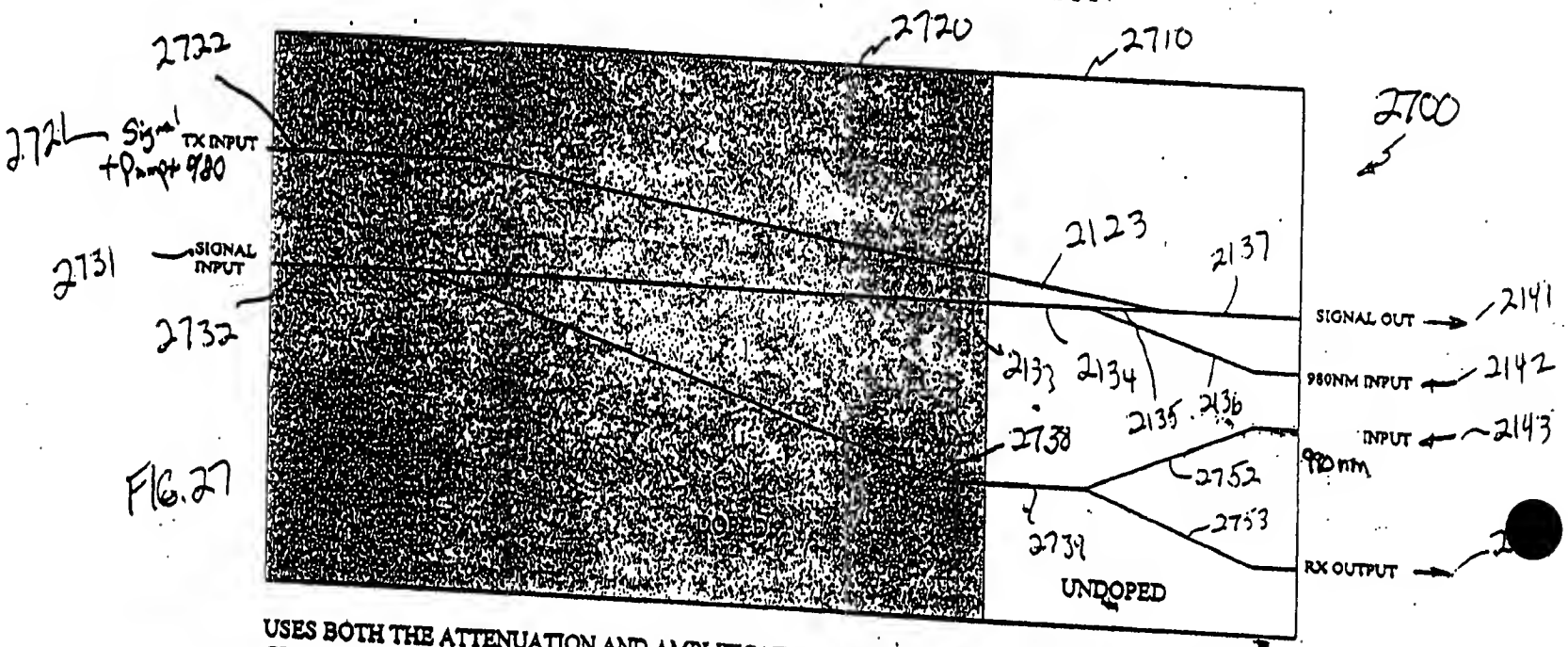

ADD/DROP NODE WITH AMPLIFICATION
2600
2622
TX INPUT
SIGNAL INPUT
2632
2610
2647
SIGNAL OUT
980NM INPUT
2652
980NM INPUT
RX SIGNAL OUT
2620
USES BOTH THE ATTENUATION AND AMPLIFICATION CHARACTERISTICS OF RARE-EARTH-DOPED GLASS TO ROUTE THE SIGNAL.

FIG. 26

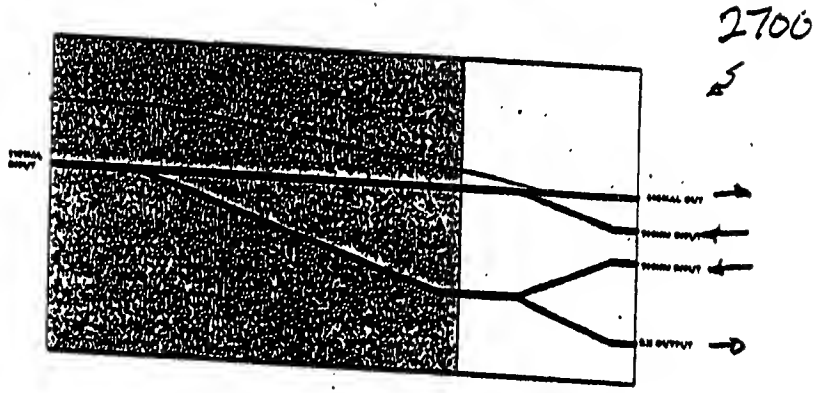
ADD/DROP NODE WITH AMPLIFICATION



F16.27

USES BOTH THE ATTENUATION AND AMPLIFICATION CHARACTERISTICS OF RARE-EARTH-DOPED GLASS TO ROUTE THE SIGNAL.

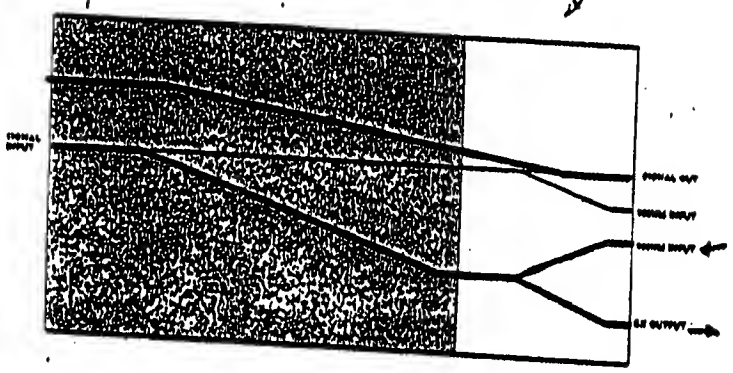
FIG. 28



AMPLIFIED PASS-THROUGH CONFIGURATION

FIG. 24

2700



ATTENUATED PASSTHROUGH AND NEW SIGNAL INJECTED

FIG. 30

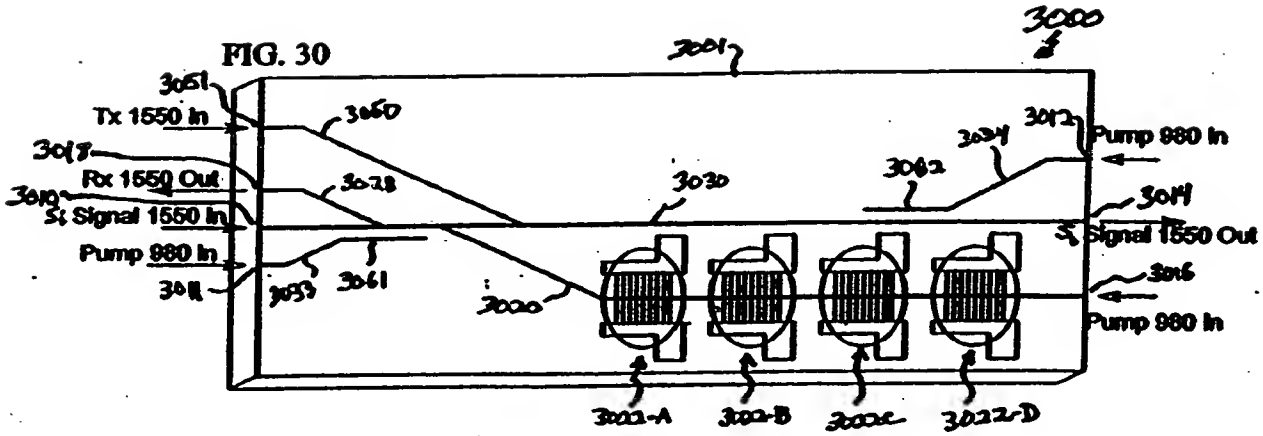

3000
3001
3051
Tx 1550 In
3050
3018
Rx 1550 Out
3052
3019
Signal 1550 In
3030
3062
3012
Pump 980 In
3034
3014
Signal 1550 Out
3016
Pump 980 In
Pump 980 In
3011
3053
3061
3000
3022-A
3022-B
3022-C
3022-D

FIG. 31

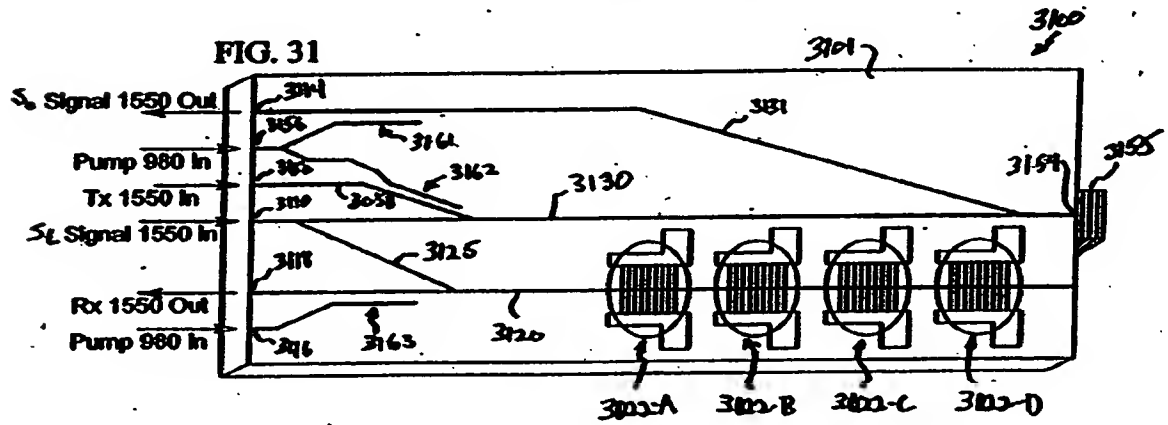

3100
3101
Signal 1550 Out
3104
3131
3164
Pump 980 In
3162
3159
3155
Tx 1550 In
3130
Signal 1550 In
3125
3118
Rx 1550 Out
Pump 980 In
3116
3163
3120
3022-A
3022-B
3022-C
3022-D

FIG. 32

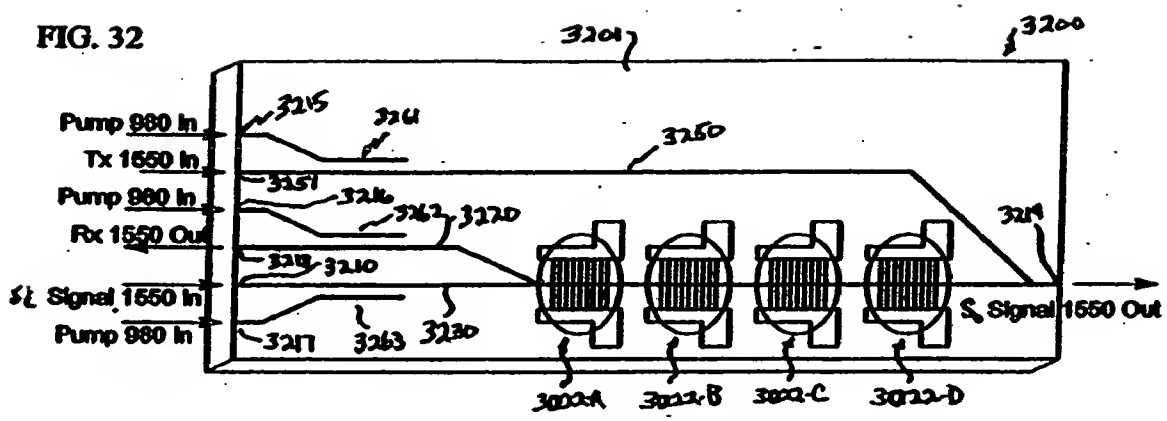

3201
3200
Pump 980 In
Tx 1650 In
Pump 980 In
Rx 1550 Out
Signal 1550 In
Pump 980 In
3215
3216
3250
3251
3218
3262
3270
3219
3210
3214
3217
3263
3230
Signal 1550 Out
3202-A
3202-B
3202-C
3202-D

FIG. 33

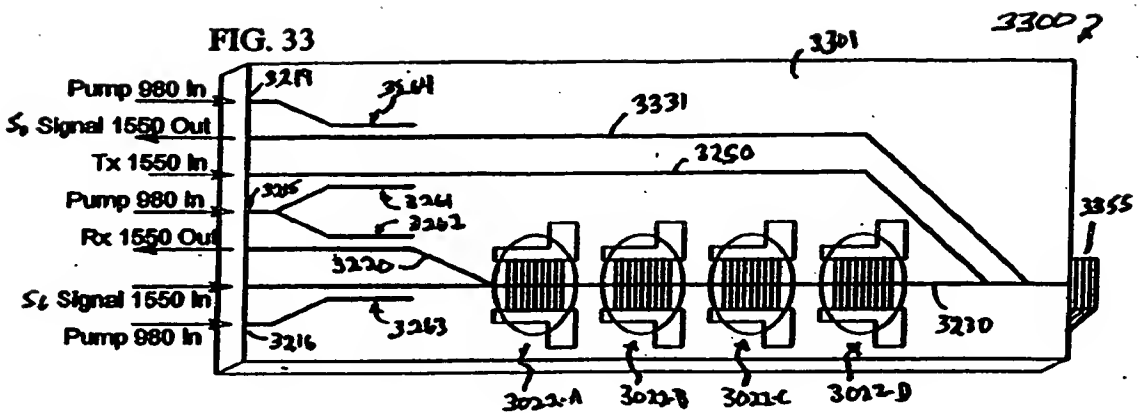


FIG. 34

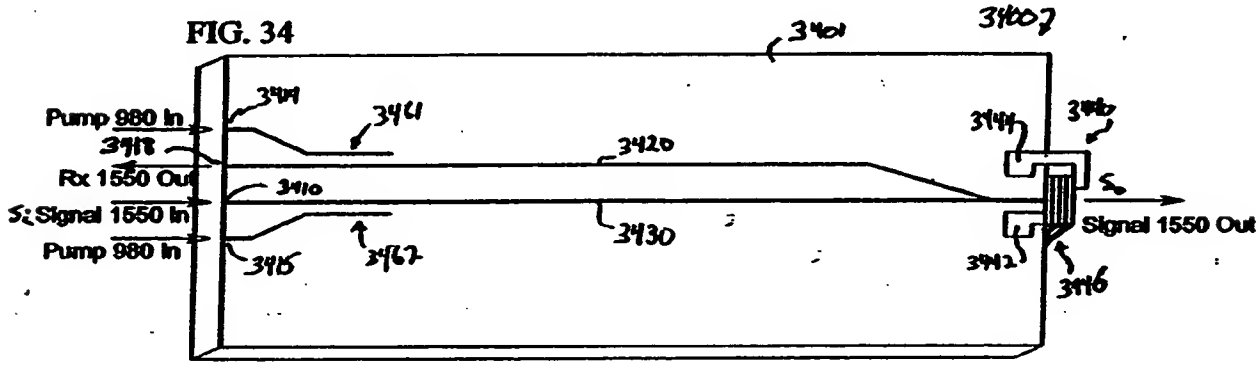


FIG. 35

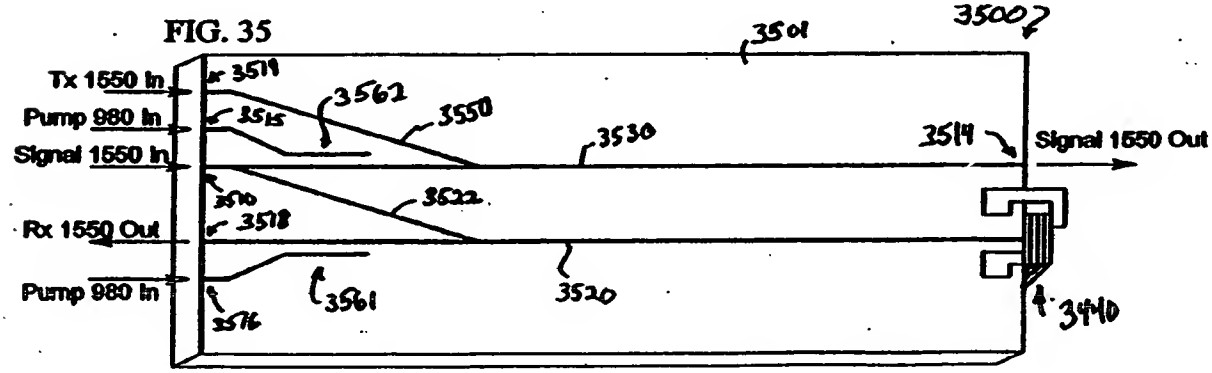


FIG. 36

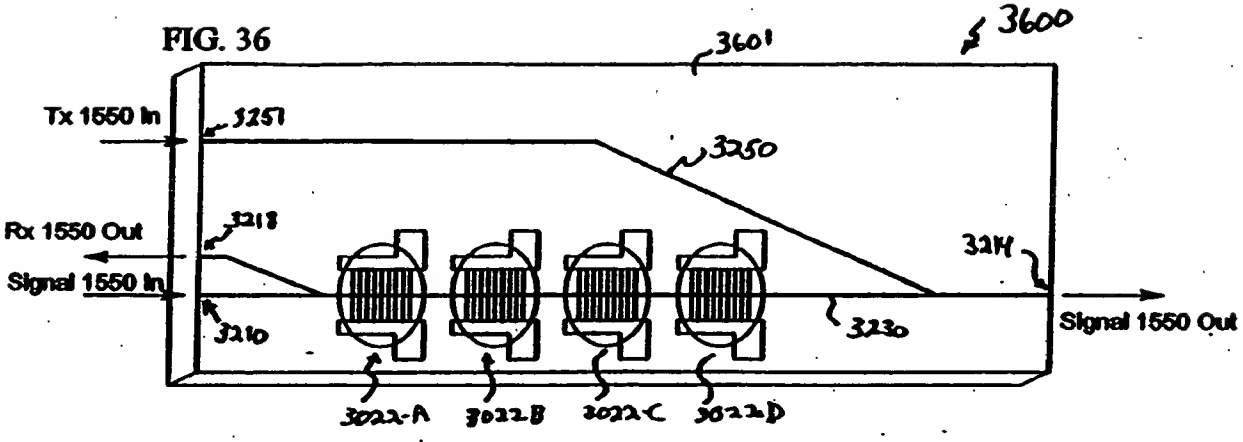


FIG. 37

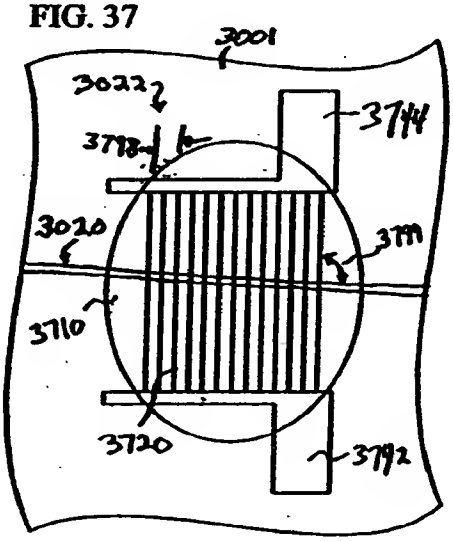


FIG. 38

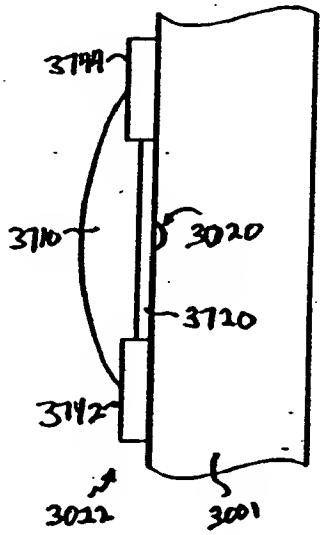


FIG. 39